Virginia Citizen's Guide to FLOODPLAIN MANAGEMENT

guidance for those living & developing in the floodplain

DCR
Virginia Department of Conservation & Recreation

TABLE OF CONTENTS

CHAPTER 1: PURPOSE AND INTENT OF THE CITIZEN'S GUIDE

A: About this Guide

This guide is designed to be a tool for land owners and developers in the Commonwealth of Virginia. This guide should not be considered comprehensive for all things relating to floodplain management, but rather a starting place to better understand those things that are generally allowed within regulated floodplains, and those things that are generally prohibited.

It should be noted that not all communities participate in the National Flood Insurance Program, although the overwhelming majority(270 counties, cities and US towns as of January 1, 2005) of Virginia communities do participate. Minimum regulations pertaining to the floodplain management are established by Federal Emergency Management Agency which relies on local officials to interpret and implement these policies.

Local ordinances should be consulted for community specific information.

B: What is the purpose of the NFIP and Floodplain Management?

The NFIP is a federally supported program that assists communities and citizens who are devastated by disasters. The majority (76%) of federally declared disasters are flood related, as most Americans live within close proximity to sources of flooding (e.g., rivers, coasts, lakes, etc.).

The role of Floodplain Management is to:

- Assist communities in avoiding potential flood losses
- Plan a course of action for when flooding occurs
- Protect the integrity of floodplains from activities that compromise their natural functions

NFIP

The National Flood Insurance Program enables property owners in participating communities to purchase insurance against losses from flooding.

C: Where Does Flooding Occur?

Flooding can occur anywhere. Flooding may exist because of poor drainage, or because of a particular location's proximity to an area referred to as a Special Flood Hazard Area (SFHA).

SFHAs are areas delineated through studies or experience that are known or thought to be at risk for flooding. SFHAs are the areas delineated on FEMA Flood Maps referred to as Flood Hazard Base Maps (FHBMs), and Flood Insurance Rate Maps (FIRMs).

These maps serve several purposes, primarily determining at what rate the premium for a subject property will be charged for Federally-backed-flood insurance. Other uses include helping community officials better provide for the safety of the residents.

SFHA (Special Flood Hazard Area)

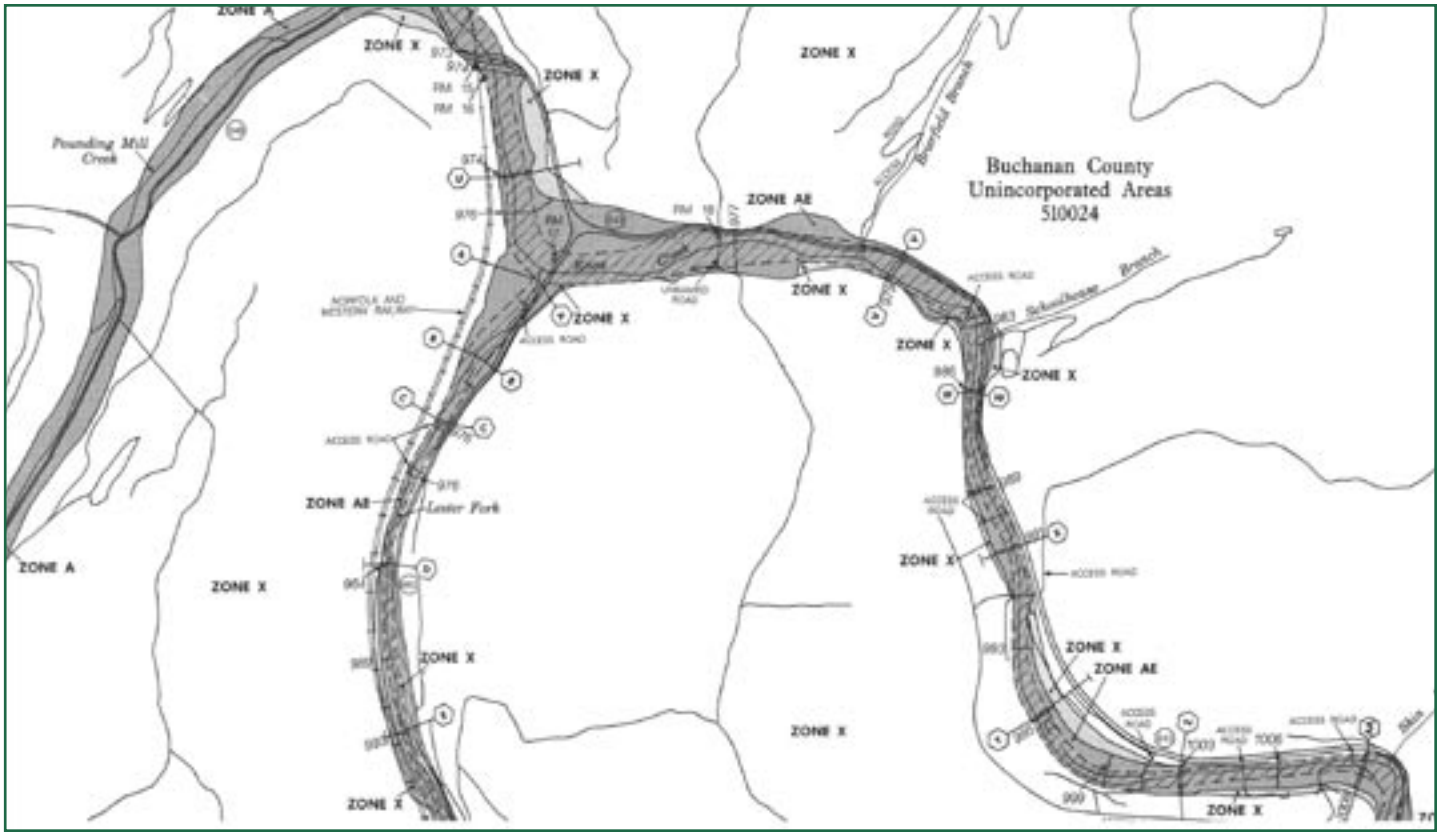
An area that has a high risk of flood inundation during the base flood.

FHBMs (Flood Hazard Base Maps)

The FHBM indicates, in general, the SFHAs within a community.

FIRMs (Flood Insurance Rate Maps)

FIRMs allow insurers to determine what rate a property should be charged for flood damage premiums.



D. Flood Insurance: Property Owners Most Effective Protection

Myths and Facts About the NFIP

Who needs flood insurance? Everyone. And everyone in a participating community of the National Flood Insurance Program (NFIP) can buy flood insurance. Nationwide, almost 20,000 communities have joined the
Program. In some instances, people have been told that they cannot buy flood insurance because of where they
live. To clear up this and other misconceptions about National Flood Insurance, the NFIP has compiled the following list of common myths about the Program, and the real facts behind them, to give you the full story about this valuable protection.

You can buy National Flood Insurance no matter where you live if your community participates in the NFIP, except in Coastal Barrier Resources System (CBRS) areas. The Program was created in 1968 to provide flood insurance to people who live in areas with the greatest risk of flooding, called Special Flood Hazard Areas (SFHAs). In fact, under the National Flood Insurance Act, lenders must require borrowers whose property is located within an SFHA to purchase flood insurance as a condition of receiving a federally regulated mortgage loan. There is an exemption for conventional loans on properties within CBRS areas. Lenders should notify borrowers that their property is located in an SFHA and National Flood Insurance is required.

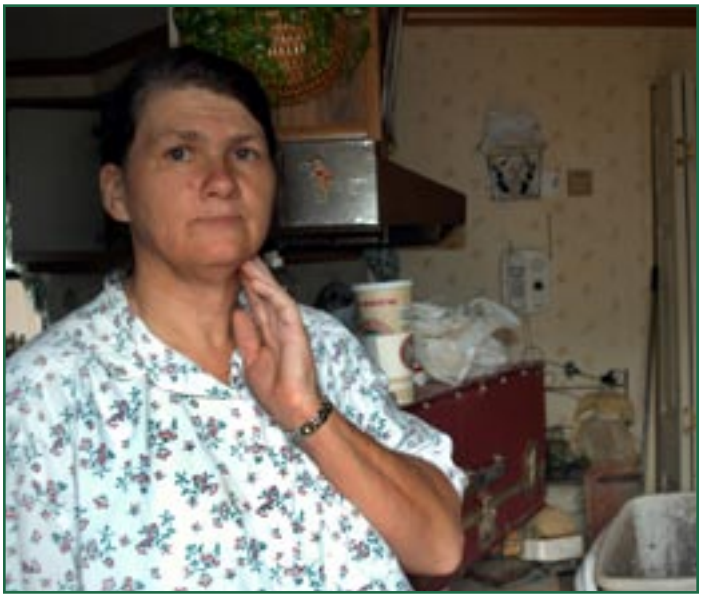
You can purchase flood coverage at any time. There is a 30-day waiting period after you've applied and paid the premium before the policy is effective, with the following exceptions:

1) If the initial purchase of flood insurance is in connection with the making, increasing, extending or renewing of a loan, there is no waiting period. The coverage becomes effective at the time of the loan, provided application and payment of premium is made at or prior to loan closing.

2) If the initial purchase of flood insurance is made during the 13-month period following the effective date of a revised flood map for a community, there is a one-day waiting period. This only applies where the Flood Insurance Rate Map (FIRM) is revised to show the building to be in an SFHA when it had not been in an SFHA.

The policy does not cover a "loss in progress," defined by the NFIP as a loss occurring as of 12:01a.m. on the first day of the policy term. In addition, you cannot increase the amount of insurance coverage you have during a loss in progress.

Maintaining a flood insurance policy is one of the most effective ways to protect yourself against the cost of flood damage. As many residents found out in the aftermath of Hurricane Floyd, homeowner policies do not cover damage from rising waters.



But those who do not have flood insurance can take steps now to protect themselves against future flood losses.

Flood insurance backed by the federal government is available to any homeowner, renter or business owner whose property is in a community that participates in the National Flood Insurance Program (NFIP). In order to participate, the community must adopt and enforce local floodplain management ordinances designed to reduce the risk of future flood losses.

If you live in such a community, you can purchase flood insurance from any licensed insurance agent or company. Premiums vary according to the flood risk your property is exposed to, the amount of coverage you purchase, the deductible you select and the type of building you are insuring.

Nationwide, the average premium is about $340 per year for approximately $98,000 of coverage.

On a single-family home, you may purchase flood insurance coverage up to a maximum of $250,000 on the structure and up to $100,000 on the contents. If you are a business owner, the maximum is $500,000 on the building and another $500,000 on contents.
Renters can purchase up to $100,000 coverage for personal belongings.

Federal disaster assistance is available only if a disaster is so large and widespread it warrants a major disaster declaration from the president.

More than 90 percent of disasters are not presidentially declared. In the majority of floods, victims are on their own — unless they have flood insurance. And even for floods that are declared major disasters, most assistance is in the form of loans that must be repaid, with interest.

Even if your neighborhood is not in a floodplain, flood insurance is advisable. Floods occur almost anywhere. Nearly 25 percent of NFIP claims come from properties considered to be in areas at low or moderate risk.

E: Virginia Floodplain Facts

Flooding is one of the most common natural disasters in the U.S. and Virginia.

The term “floodplain” is often used to describe any area subject to flooding. The source of that flooding may be coastal, riverine or nuisance related.

Here are a few facts about flooding in the U.S.

- There is a 26% chance of experiencing a flood during the life of a 30-year mortgage compared to a 4% chance of a fire. (Ref: Federal Insurance Statistics)
- The average annual costs from flood damage in the USA have increased dramatically over the past half-century, from $1.5 billion in 1950 to $4 billion today. Between 1995 and 1999 alone, flood damages topped $40 billion. Sound flood mitigation planning and watershed management are key to preventing loss of life and property caused by flooding. (DHI/PBS&J Consultants Press Release, 2004)
- Every year, flooding causes more than $2 billion of property damage in the U.S.
- The NFIP awarded over $601 million in flood claims in 2003
- Since 1969, the NFIP has paid $12.7 billion for flood insurance claims and related costs
- About 4.5 million people currently hold flood insurance policies in more than 20,000 communities across the U.S.

Here are a few facts about flooding in the U.S.

- Since 1969 there have been 34 Presidential Disaster Declarations in Virginia out of these 26 (76%) have involved flooding
- Since 1978, more than $370 million has been paid out in Virginia under the National Flood

Disclosure Program

F: Want to Learn More?

For information about the laws, regulations or administrative policies related to the NFIP:

- US Department of Homeland Security
  Federal Emergency Management Agency
  Mitigation Division
  500C Street SW
  Washington, DC 20472

- FEMA Region III Office
  6th Floor
  615 Chestnut Street
  Philadelphia, Pennsylvania 19106
  215-931-5608

For insurance questions: call local property insurance agents or brokers or call the NFIP toll-free at 1-800-427-4661

General information may obtained as follows:

FEMA on the Web – www.fema.gov
NFIP on the Web – www.fema.gov/nfip or www.floodsmart.gov

To order Flood Insurance Rate Maps, Digital Data or other FEMA documents and resources on the web, go to www.msc.fema.gov or contact:

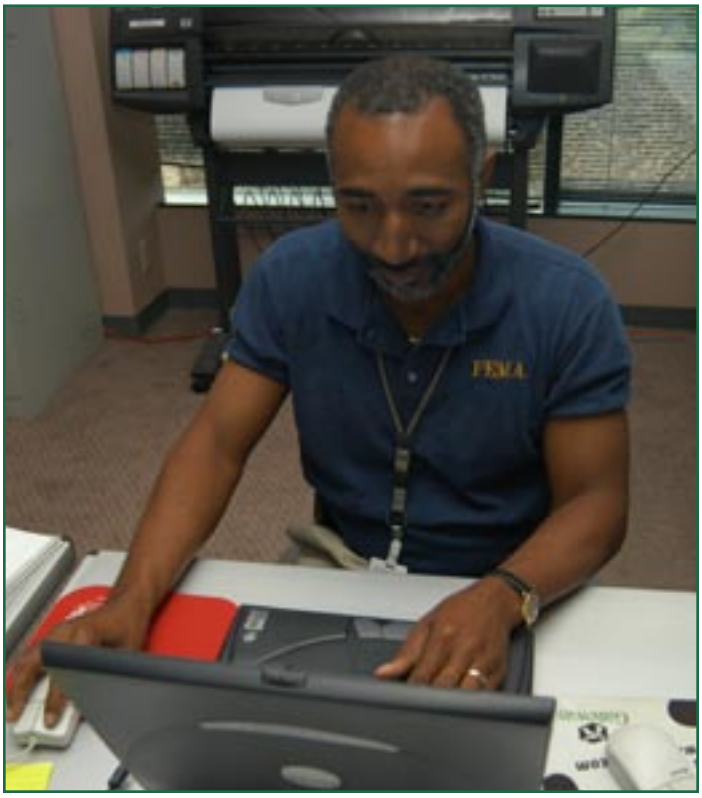
Federal Emergency Management Agency
Map Service Center
PO Box 1038
Jessup, Maryland 20794-1038
Phone: 1-800-358-9616
Fax: 1-800-358-9620

For information pertaining to hazard identification mapping and floodplain management:

Contact your local community administrator or the Virginia NFIP Coordinator at the Division of Dam Safety and Floodplain Management at the Virginia Department of Conservation and Recreation at (804)786-1712.

Professional organizations that may be able to help with floodplain related problems Include:

Association of State Floodplain Managers
(www.floods.org)
Virginia Floodplain Managers Association
(www.vaflood.org)
American Society of Civil Engineers
(www.asce.org)
National Flood Determination Association
(www.floodassoc.com)



A: Understanding the Riverine Floodplain

Flood hazards within the largest geographical area of Virginia fall into the those related to riverine flooding. This means that flood hazards result from streams, rivers and tributaries that overtop their banks during high flow events.

One way of thinking about riverine or upland flooding is that the water is trying to make its way to lower elevations by overland routes.

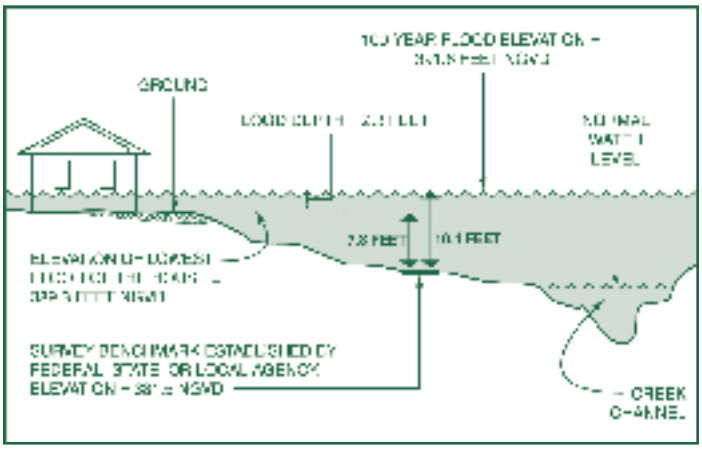
How Flooding Can Damage Your House

To understand how flooding can damage your house, you need to know about six important flood characteristics: depth/elevation, flow velocity, frequency, rate of rise and rate of fall, duration, and debris load. Most of these characteristics apply to both riverine and ocean flooding, and they can vary – sometimes greatly – from one place to another. The flood conditions at a particular site, such as the location of your house, are determined largely by the combination of these characteristics. The following paragraphs explain these characteristics. The section Federal, State and Local Regulations, which you'll find later in this chapter, and Chapter 4 explain how you can find out about the flood conditions at your house.

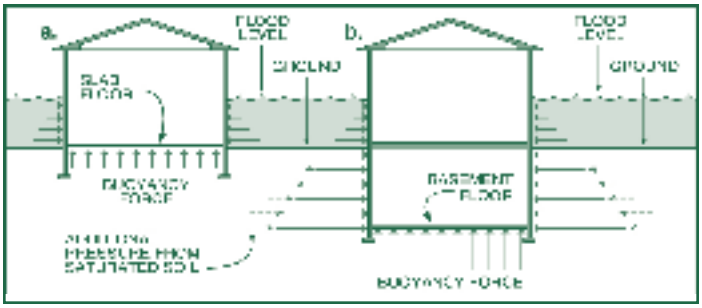
Depth/Elevation of Flooding

The depth and elevation of flooding are so closely related that they can be viewed as a single characteristic for the purposes of this discussion Flood depth is the height of the flood water above the surface of the ground or other feature at a specific point. Flood elevation is the height of the flood water above an established reference datum. The standard datums used by most Federal agencies and many State and local agencies are the National Geodetic Vertical Datum (NGVD) and the North American Vertical Datum (NAVD); however, other datums are in use. The use of other datums is important because elevations of the ground, flood waters, and other features cannot be meaningfully compared with one another unless they are based on the same datum.

When the elevation of the ground (or another surface such as the lowest floor of your house) and the elevation of the flood water are both based on the same datum, the flood depth at any point is equal to the flood elevation at that point minus the elevation of the ground (or other surface) at that point. One more thing you should know: ground elevations are established by surveys; flood elevations may be calculated or they may be known from water

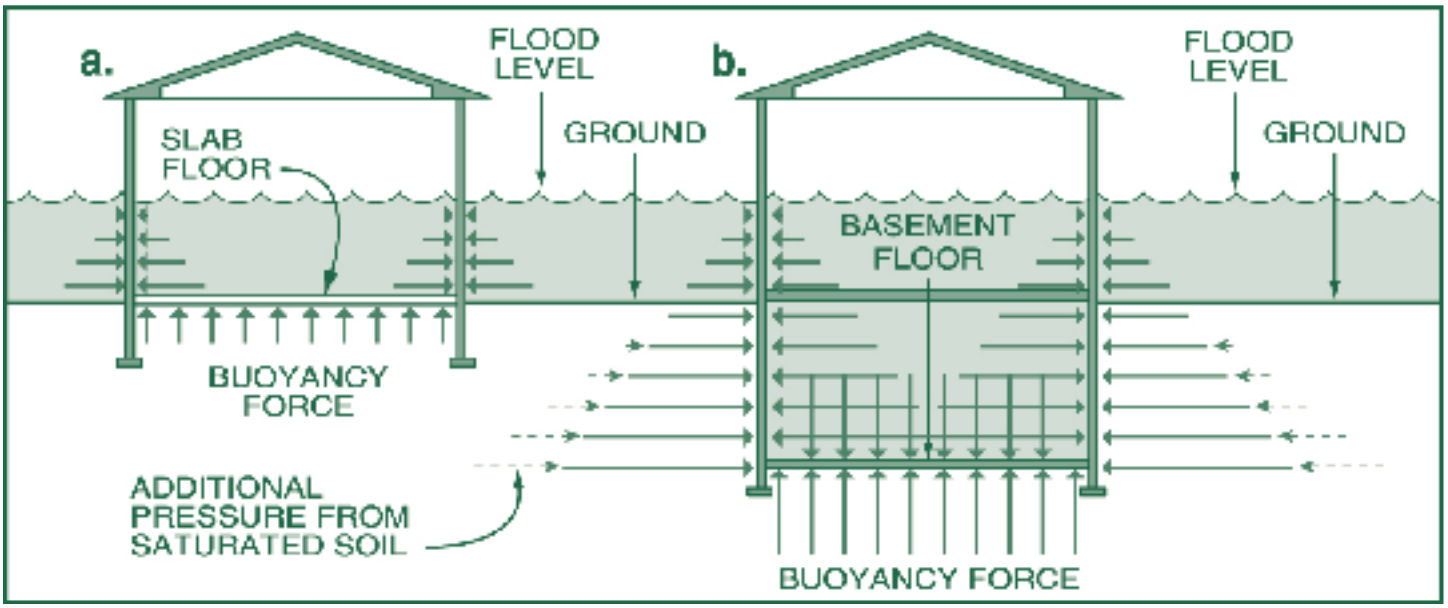


In this example, the 100-year flood elevation is 391.6 feet (10.1 feet above the benchmark elevation of 381.5 feet), and the elevation of the lowest floor of the house is 389.3 feet (7.8 feet above the same benchmark). The flood depth above the lowest floor is therefore equal to 391.6 feet - 389.3 feet, or 2.3 feet during the 100-year flood.



Hydrostatic pressure acts on walls and concrete slab floors. The weight of saturated soils adds to the pressure on basement walls. Figure 2-7a shows a house with a concrete slab floor. Figure 2-7b shows a house with a basement.

marks left by past floods.



Once water enters thehouse, hydrostatic pressure is equalized.Figure a shows a house with a concrete slab floor. Figure b shows a house with a basement.

Flow Velocity

Flow velocity is the speed at which flood waters move. It is usuallymeasured in feet per second, abbreviated as “fps.” Flow velocitiesduring riverine floods can easily reach 5 to 10 fps, and in somesituations may be even greater. 10 fps is roughly equal to 7 miles per hour.

The velocity of riverine flood waters depends on a number of factors; one of the most important is the slope of the stream channel and floodplain. As you might expect, flood waters will generally move much faster along streams in steep mountainous areas than streams in flatter areas.

If your house is in an area where flood waters are flowing, especially ifthey are moving more than about 5 fps, the flow velocity is important for several reasons. Flowing water pushes harder on the walls of a building than still water. So instead of just the hydrostatic pressure caused by the weight of the flood water resting against the walls of your house, you have the additional pressure of moving water, referred to as “hydrodynamic pressure”.

Flood Frequency

You may have been told that your house is in the 100-year floodplain,or you may have heard that term used to describe a specific flood. You may also have heard similar terms used, such as 50-year flood or 500-year flood. These terms are occasionally used incorrectly and can be misleading. Flood frequencies are usually determined through statistical and engineering analyses performed by floodplainmanagement agencies and other organizations who need information on which to base engineering designs and flood insurance rates.

For example, the flood that has a 1-percent probability (1 in 100) ofbeing equaled or exceeded in any year is

referred to as the 100-yearflood. This term is simply a convenient way to express probability. It should not be interpreted to mean a flood that happens exactly once every 100 years. Nor does it imply that once a 100-year flood occurs, there is little risk of another 100-year flood occurring in the near future.

For most homeowners, the value of these terms is that they indicaterelative frequencies and sizes. On the average over a long period, a100-year flood is expected to occur less often than a 50-year flood andmore often than a 500-year flood.

The 100-year flood is particularly important for homeowners because itis the basis of NFIP flood insurance rates and regulatory floodplainmanagement requirements.

Rate of Rise and Rate of Fall You may not have heard these terms before, but they describe important characteristics of flooding: how rapidly the elevation (and therefore the depth) of water increases and decreases during a flood.These rates are usually expressed in terms of feet or inches per hour. Flood waters with high flow velocities, such as those in areas of steep terrain, and water released by the failure of a dam or levee, usually rise and fall more rapidly than slower-moving floodwaters, such as those in more gently sloping floodplains.
Rate of rise is important because it affects how much warning you will have of an impending flood. In the floodplains of streams with high rates of rise, homeowners may have only a few hours' notice of a coming flood or perhaps none at all.

Rate of rise and rate of fall are important also because of their effecton hydrostatic pressure. As explained in the discussion of flood depth/elevation, hydrostatic pressure is most dangerous for a house when the internal and external pressures are not equalized. This situation occurs when the level of water inside the house is significantly higher or lower than the level outside.

Duration
Duration is how long a flood lasts. One of the meanings of duration is how long is takes for the creek, river, bay, or ocean to return to its normal level. As a homeowner, you may be more interested in how long flood waters remain in or around your house or perhaps how long they block nearby streets. In many floodplains, duration is related to rate of rise and rate of fall.

If your house is flooded, duration is important because it determineshow long the structural members (such as the foundation, floor joists,and wall studs), interior finishes (such as drywall and paneling),service equipment (such as furnaces and hot water heaters), and building contents will be affected by flood waters. Long periods of inundation are more likely to cause damage than short periods.

Debris Impact
Flood waters can pick up and carry objects of all types – from small to large, from light to heavy – including trees, portions of flood-damaged buildings, automobiles, boats, storage tanks, mobile homes, and even entire houses. In cold climates, wintertime floods can also carry large pieces of ice. Dirt and other substances such as oil, gasoline, sewage,and various chemicals can also be carried by flood waters. All of these types of debris add to the dangers of flooding.

B: Floodplain Mapping

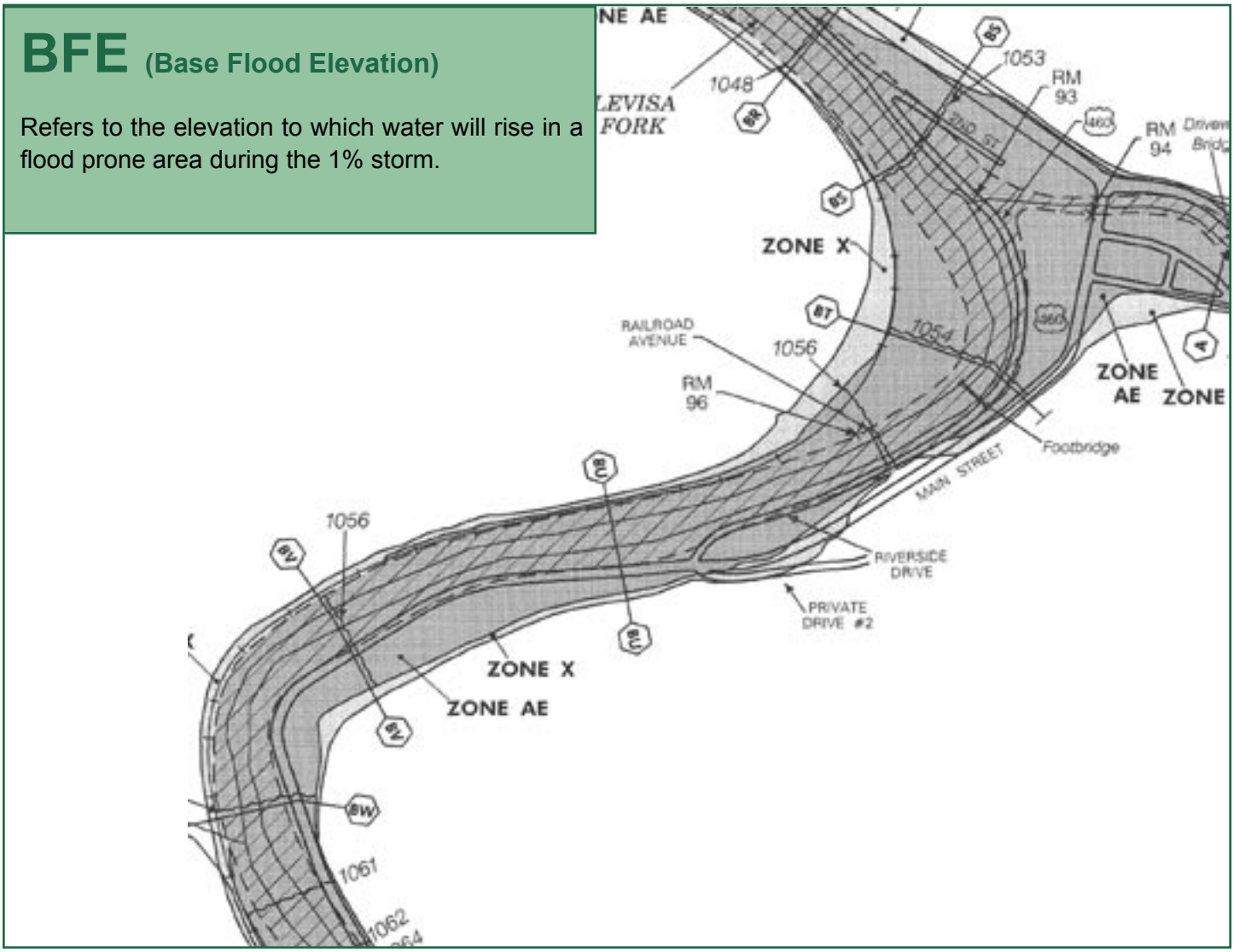
Below is an example of a FEMA FIRM that shows the information typically provided to assess hazard potential. These maps can show:

- Limits of the Floodplain (Zone AE)
- Base Flood Elevations
- Limits of Approximate Floodplain Areas (Zone A)
- Limits of the 500-year Floodplain (Zone X)

FIRM panels, as seen in the preceding figure, provide boundary information for determining whether a property or structure lies in the floodplain, and is subject to higher insurance rates. However, the mapping of floodplains in most cases is approximate, and can only be trusted to the degree of accuracy that exists with the mapping

BFE (Base Flood Elevation)

Refers to the elevation to which water will rise in a flood prone area during the 1% storm.



process.

C. Approximate Flood Zones

Much of Virginia is mapped by approximate methods, and therefore should be closely scrutinized prior to determining whether a property or structure is subject to flooding during the base flood event. In many cases, local officials will require a more detailed approach be taken prior to obtaining building permits.

In instances where detailed studies have been performed, the source of the data should still be questioned. In most cases, the overbanks of a flooding source use less accurate survey data than that used in the channel, therefore slight discrepancies may occur. The process that should be used is to

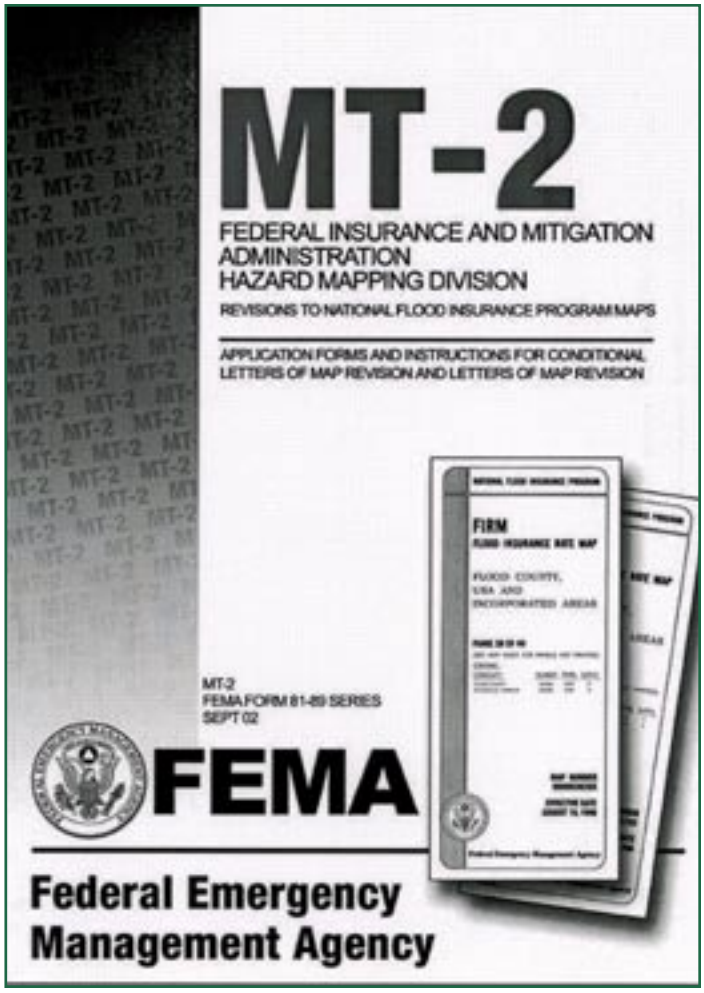
- Check the flood profile for the elevation at the subject property
- Determine the elevation of the subject property

Even though the subject property is shown within the boundaries of the floodplain on the FIRM panel, the elevation will control the actual determination.
In cases where there is a question that still remains, FEMA provides standard forms (MT-EZ and Elevation Certificates) that can be prepared by a community's floodplain official or a licensed engineer or surveyor for the purpose of obtaining an official ruling from FEMA. This ruling, referred to as a Letter of Map Change (e.g. LOMR, CLOMR), may be required to reduce insurance premiums.

Reference: Managing Floodplain Development in Approximate Zone A Areas (FEMA-265)

D. What is the distinction between a Floodplain and a Floodway?

The floodplain shown on FIRMs is the area which would be expected to be inundated during the Base Flood, generally taken to be the 1% chance event for current land-use conditions. FEMA allows two alternatives for assessing the impacts of development within the floodplain. The first is to assess hydraulic conditions associated with the pre- and post-development

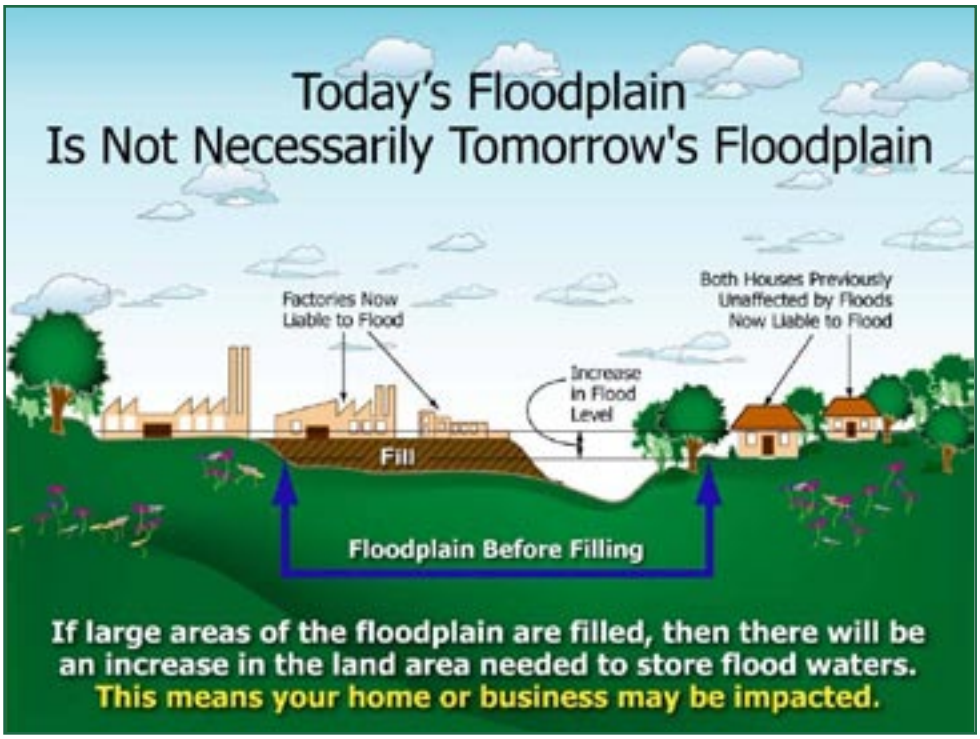


floodplain geometry.
While the model ordinance is interpreted by each locality slightly different, and each community is allowed to enforce regulations beyond the minimum, the general interpretation is that assuming this floodplain development does not result in increases to flood elevations of more than one foot, then the development is allowed.

The problem with this approach is twofold:

- First, it allows development on one side of the floodplain to affect the base flood elevation without the owner of the opposing bank being given an equal opportunity (i.e. first come, first serve).
- Second, it requires multiple small scale analyses to be performed using a variety of analytical methods before the ultimate, cumulative impact can be assessed.

The alternative to this is to determine what the maximum encroachments would be along an entire reach of study area using objective methods that equally account for development along both sides of the flooding source. The process used to accomplish this is referred to as a Floodway Analysis. A Floodway Analysis shrinks the width of a floodplain by assuming an equal amount of conveyance is removed from both sides of the flooding source in an iterative manner until the base flood elevation is ideally raised precisely one foot. In no case may the floodway limits be outside of the floodplain, nor inside the channel banks, and the areas between the floodway and floodplain delineations are referred to as the "Floodway Fringe." The process is certainly not without flaws, but if conducted properly should objectively allow maximum encroachment into the floodplain. It should be remembered that communities may have an allowable increase of less than 1.0'.



E. Lake Flood Hazards

Lake areas present a number of specific issues due to their function within a watershed. While upstream of a large impoundment is generally not subject to rapid changes in water surface elevation due to the relatively large surface area upon which flood waters are stored, there are several issues specifically related to lakes that should be considered under the general purview of Floodplain Management.

Flooding in and around lakes and reservoirs is usually minimal upstream of the impoundment structure. Elevations generally do not fluctuate more than a few feet, however, homeowners should be aware of the maximum elevation that the facility is designed to accommodate. This elevation, which most property owners would want to build above, may be greater than the water surface elevation associated with the base flood (i.e. 1% chance event).

Large impoundments are regulated by the state and information on elevations can be found through DCR's (Department of Conservation and Recreation) Division of Dam Safety and Floodplain Management. Alternatively, the structures may be operated by the Federal Government (e.g. NRCS or US Army COE), who can assist in determining safe elevations for building.

Flood risk downstream of an impoundment, however, is significant. Particularly with older structures that have not been well maintained. In most cases, the flood inundation zone associated with a dam failure, is not reflected on flood maps maintained by FEMA or local floodplain administrators. Therefore, the risk may appear to be artificially low through normal NFIP processes. Prospective and current property owners should verify the limits of both sources of flooding prior to placing themselves at risk.

For more information, contact the Virginia Department of Conservation and Recreation's Division of Dam Safety and Floodplain Management.

A. Understanding the Coastal Floodplain

Being a coastal state, Virginia is susceptible to coastal storms and the damage that occurs as a result. Coastal hazards typically result from two types of events in Virginia.

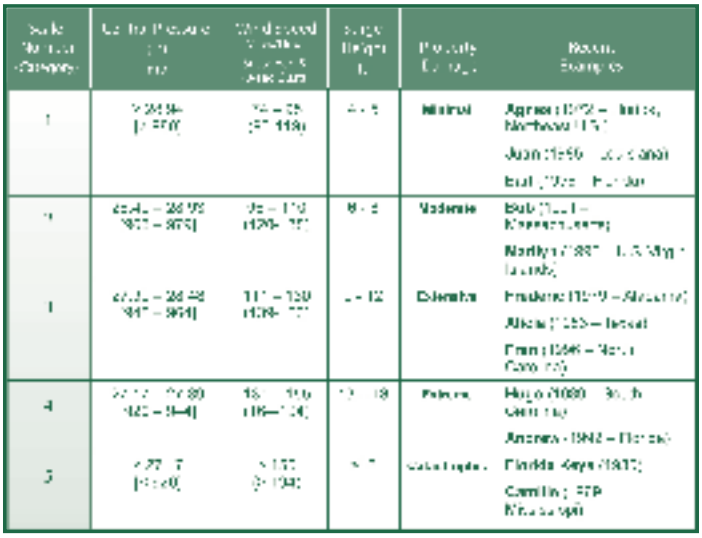
- Perhaps the most devastating, is the tropical storms generated in the Atlantic that move up the coast and come ashore in the vicinity of the Commonwealth, and also those that come ashore in the Gulf of Mexico and move across the southeastern states until ultimately crossing Virginia. These events often bring with them high winds and large amounts of rain.

Occasionally tropical storms can develop into hurricanes ehich can have awesome destructive forces.

The Power of Hurricanes

Walls torn from concrete buildings, 15-foot trees ripped from the earth, 20-footwaves crashing to shore. The power ofhurricanes is awesome. Hurricanes can spawn tornadoes. Floodsand flash floods are generated by torrentialrains that accompany hurricanes.Even more dangerous is the storm surge— a dome of ocean water that, at its peak,can be 20 feet high and 50-100 mileswide. The surge can devastate coastalcommunities as it sweeps ashore.Ahurricane is a tropical weather systemwith winds that have reached a sustainedspeed of 74 mph or more. Hurricane windsblow in a large spiral around a relativelycalm center, known as the “eye.”The eye is generally 20-30 miles wide,and the storm may extend outward from itfor 400 miles.As a hurricane approaches, the sky dark-ens and winds strengthen. As a hurricanenears land, it can bring torrential rains,high winds and storm surges.Asingle hurricane can last more than twoweeks over open waters and can run alongthe entire length of the eastern seaboard.The 74-160 mph winds can extend inlandfor hundreds of miles.Hurricanes are classified into five cate-gories according to wind velocity. Cate-gory 1 is the mildest, with winds from 74-95 mph. Category 5 is strongest, withwinds above 155 mph.August and September are peak months of hurricane season, which lasts from June 1 through November 30.

Saffir-Simpson Hurrican Scale



- The second type of coastal hazard that commonly affects Virginia is the Northeaster extra-tropical event that is generated along the Atlantic coast, usually in the winter months. These storms can cause wave heights similar to those generated during Hurricanes.

In Virginia, an inordinately large percentage of the flood insurance policies are issued in the southeastern part of the state. This may be due to a number of factors including population, age of structures and the level of management within the local communities.

B. Coastal Flood Studies

Coastal flood studies are used to establish a base flood and the associated SFHA, but may also designate a coastal high hazard area (V Zone). Coastal flooding models take into account storm surge, or the water that is "pushed" onto the coast by strong winds and air pressure changes and is considered static. The other element that is taken into account is the dynamic action of waves and how their height relates to the still-water elevation of the surge. The location of the actual measurements taken in coastal flood modeling is referred to as transects. The V Zones are areas where the velocity of the wave action should be considered as part of the hazard.

FEMA's primary means of establishing Base Flood Elevations (BFEs) and distinguishing between V zones, (coastal) A zones, and X zones is the wave height. The wave height is simply the vertical distance between the crest and trough of a wave propagating over the water surface. BFEs in coastal areas are usually set at the crest of the wave as it propagates inland.The maximum wave crest elevation (used to establish the BFE) is determined by the maximum wave height, which depends largely on the 100-years till water depth. This depth is the difference between the 100-years till water elevation and the ground elevation.

On steeply sloped shorelines, the rush of water up the surface of the natural beach, including dunes and bluffs, or the surface of a manmade structure, such as a revetment or vertical wall, can result in flood elevations higher than those of the crests of wind-driven waves. For a coastal flood hazard area where this situation occurs, the BFE shown on the FIRM is equal to the highest elevation reached by the water.

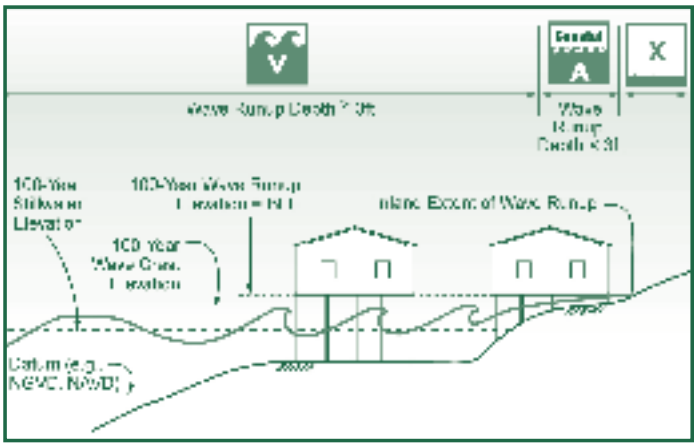
Another feature on a Coastal FIRM is what is referred to as COBRA zones. COBRA zones are those areas subject to the Coastal Barriers Resources Act of 1982 and subsequent amendments. COBRA restricts ANY federal program from encouraging development in these areas. This includes: loans, grants, guarantees, insurance, payments rebates, or any other form of direct or indirect Federal assistance. Areas deemed COBRA zones are protected due to the protection they provide inland areas.

7.2 Natural Hazards Affecting Coastal Areas
The most significant natural hazards that affect the coastlines of the United
States and its territories can be divided into five general categories:

- coastal flooding
- high winds
- erosion
- earthquakes
- other hazards

C. Coastal Hazards

Coastal flooding can originate from a number of sources. Tropical cyclones, other coastal storms, and tsunamis generate the most significant coastal flood hazards, which usually take the form of hydrostatic forces, hydrodynamic forces, wave effects, and floodborne debris effects.



Where wave runup elevations exceed wave crest elevations, the BFE is equal to the runup elevation.

Hydrostatic Forces
Standing water or slowly moving water can induce horizontal hydrostatic forces against a structure, especially when floodwater levels on different sides of the structure are not equal. Also, flooding can cause vertical hydrostatic forces or flotation.

Hydrodynamic Forces
Hydrodynamic forces on buildings are created when coastal floodwaters move at high velocities. These high-velocity flows are capable of destroying solid walls and dislodging buildings with inadequate foundations. Highvelocity flows can also move large quantities of sediment and debris that can cause additional damage.

Waves
Waves can affect coastal buildings in a number of ways. The most severe damage is caused by breaking waves. The force created by waves breaking against a vertical surface is often 10 or more times higher than the force created by high winds during a storm event.

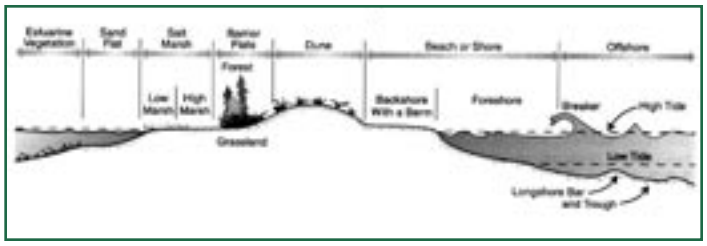
Floodborne Debris
Floodborne debris produced by coastal flood events and storms typicallyincludes decks, steps, ramps, breakaway wall panels, portions of or entirehouses, heating oil and propane tanks, vehicles, boats, decks and pilings from piers, fences, destroyed erosion control structures, and a variety of smaller objects. Floodborne debris is often capable of destroying unreinforced masonry walls, light wood-frame construction, and small-diameter posts and piles.

Sea-Level Rise and Lake-Level Rise
The coastal flood effects described above typically occur over a period of hours or days. However, longer-term water level changes also occur. Sea level tends to rise or fall over centuries or thousands of years, in response to long-term global climate changes. Great Lakes water levels fluctuate overdecades, in response to regional climate changes. In either case, long-term increases in water levels increase the damage-causing potential of coastalflood and storm events and often cause a permanent horizontal recession of the shoreline.

Tide gauge records for the U.S. Atlantic and Gulf of Mexico coasts show thatrelative sea level has been rising at long-term rates averaging 2 to 4 mm annually, with higher rates along the Louisiana and Texas coasts (Hicks et al.1983).

Erosion
Erosion refers to the wearing or washing away of coastal lands. Although the concept of erosion is simple, erosion is one of the most complex hazards tounderstand and predict at a given site.

Erosion is capable of threatening coastal residential buildings in a numberof ways:
- destroying dunes or other natural protective features
- destroying erosion control devices
- lowering ground elevations, undermining shallow foundations, and reducing penetration of deep foundations such as piles.
- supplying overwash sediments that can bury structures farther landward (Note that overwash can permanentlyreduce the width and elevation of beaches and dunes by transportingsediments landward into marsh areas, where its recovery is difficult, if not impossible
- breaching low-lying coastal barrier islands, destroying structures at the site of the breach and sometimes exposing structures on the mainland to increased flood and wave effects
- washing away low-lying coastal landforms
- eroding coastal bluffs that provide support to buildings outside the floodplain itself



A: Identifying and Evaluating Suitable Development Sites

For buildings constructed in coastal floodplain areas, and particularly in V zones, special considerations must be given to the unique risks associated with Coastal flooding. These considerations require building construction to conform with certain codes that help mitigate losses due to coastal flood events. The following image provides some guidance on what requirements must be met when building in a coastal high hazard zone.

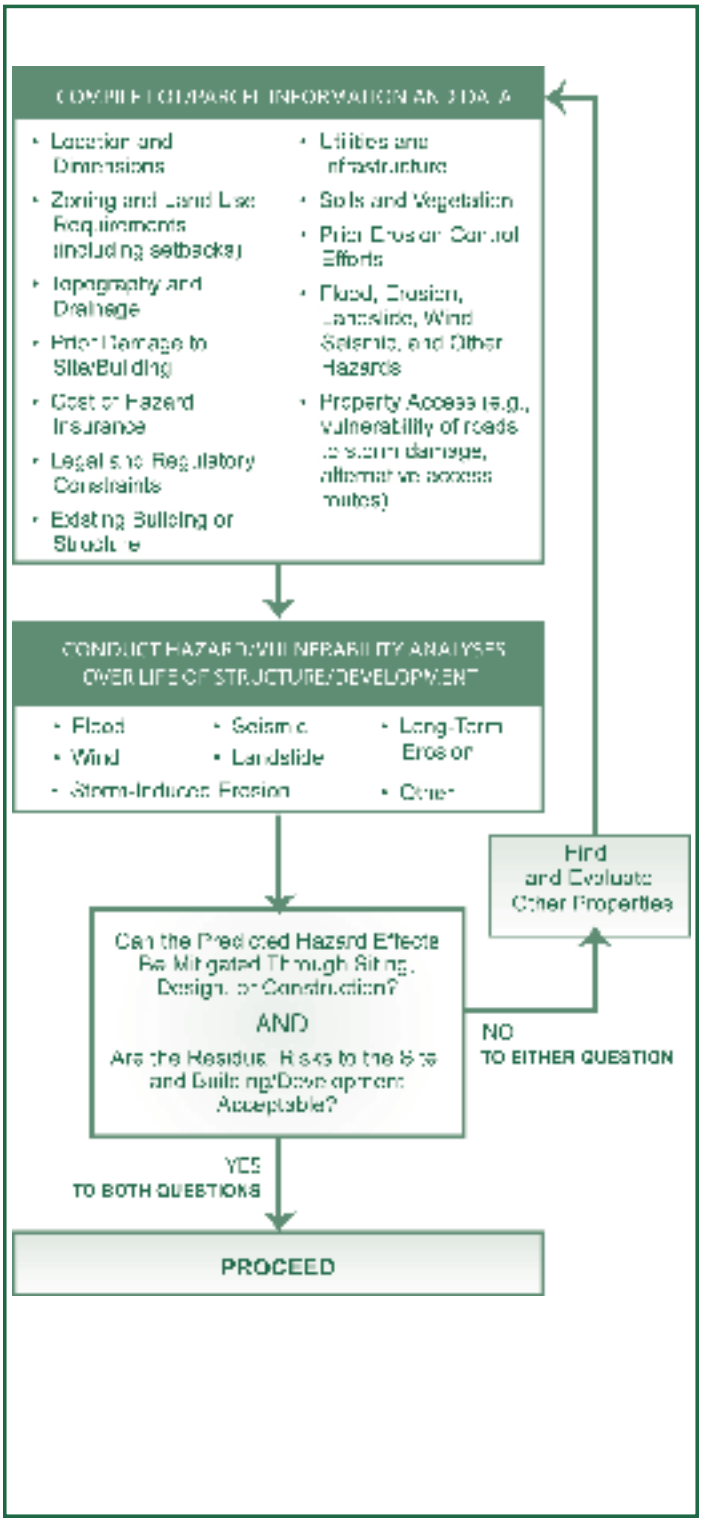
Informed decisions regarding siting, design, and construction begin with a complete and detailed understanding of the advantages and disadvantages of potential sites for coastal residential construction.

A thorough evaluation of coastal property for development purposes involves four steps

1. Compile lot/parcel information for one or more candidate properties and for each property follow steps 2 through 4:
2. Conduct a hazards analysis and risk assessment.
3. Determine whether the hazards can be mitigated through siting,design, or construction and whether the residual risks to the site and the building are acceptable.
4. Either proceed with the purchase or development of a property, or reject the candidate properties, and find and evaluate other properties.

A building or development site need not be vacant or undeveloped land; indeed, much of the coastal construction occurring today involves redevelopment or replacement of existing buildings.

Evaluation of coastal property.



Siting residential buildings to minimize their vulnerability to coastal hazards is one of the most important aspects of the development (or redevelopment)process. Unfortunately, prudent siting has often been overlooked or ignored in the past as properties have been developed and buildings have been constructed close to the shoreline, near bluff edges, and atop steep coastal ridges. There are literally hundreds, if not thousands, of examples where residential buildings have been constructed with little regard for coastal hazards, only to suffer what could have been preventable damage or loss.

A variety of factors must be considered in selecting a specific site and locating a building on that site:

- regulatory requirements
- presence and location of infrastructure
- previous development and/or subdivision of property
- physical and natural characteristics of the property
- vulnerability of the property to coastal hazards

A thorough review of these factors will sometimes show that minimum regulatory requirements and/or previous subdivision/infrastructure decisions allow or constrain future development onto sites that will be highly vulnerableto the effects of coastal hazards. In other words, regulatory controls do not necessarily result in prudent siting of coastal buildings. Likewise, constraints imposed by previous lot creation and infrastructure construction sometimes drive development to more hazardous locations.

Although these situations should have been discovered when the property was first evaluated for its suitability for purchase, development, or redevelopment, it is common practice for property owners to undertake detailed studies only after property has been acquired.

B. Coastal Floodplain Building Standards

The insurance zone designations shown on FIRMs indicate the magnitude and severity of flood hazards. V zones identify the Coastal High Hazard Area, which is the portion of the SFHA thatextends from offshore to the inland limit of a primary frontal dune along an open coast and any other portion of the SFHA that is subject to high-velocity wave action from storms or seismic sources. V zones are generally based on wave heights (3 feet or greater) or wave runup depths (3 feet or greater).

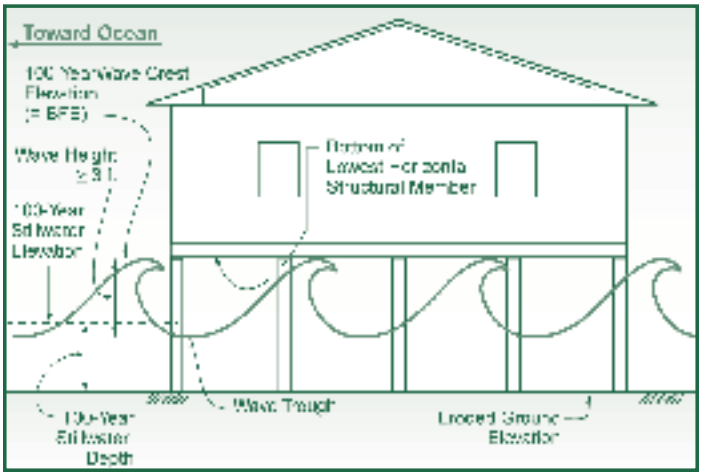
The minimum requirements enforced by participating communities regarding newly constructed buildings, substantially damaged buildings, and substantially improved buildings in V Zones pertain to the siting of the building, the elevation of the lowest floor in relation to the BFE, the foundation design, enclosures below the BFE, and alterations of sand dunes and mangrove stands (refer to 44 CFR 60.3(d)).

Siting

All newly constructed buildings must be located landward of the reach ofmean high tide (i.e., the mean high water line). In addition, manmadealterations of sand dunes or mangrove stands are prohibited if those alterations would increase potential flood damage. Removing sand or vegetation from, or otherwise altering, a sand dune or removing mangroves may increase potential flood damage; therefore, such actions must not be carried out without the prior approval of a local official.

Building Elevation

All newly constructed, substantially damaged, and substantially improvedbuildings must be elevated on pilings, posts, piers, or columns so that the bottom of the lowest horizontal structural member of the lowest floor(excluding the vertical foundation members) is at or above the BFE.



Minimum NFIP V-zone requirements: In V zones, buildings must be elevated on an open foundation (e.g.,pilings, posts, piers, or columns) so that the bottom of the lowest horizontal structural member is at or above the BFE.

Foundation Design

The piling or column foundations for all newly constructed, substantially damaged, and substantially improved buildings, as well as the buildings attached to the foundations, must be anchored to resist flotation, collapse, and lateral movement due to the effects of wind and water loads acting simultaneously on all components of the building. A registered engineer or architect must develop or review the structural design, construction specifications, and plans for construction and must certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the building elevation and foundation design standards described above.

Use of Fill

Fill may not be used for the structural support of any building within V Zones. Fill may be used in V zones for minor landscaping and site drainage purposes (consult local officials for specific guidance or requirements).

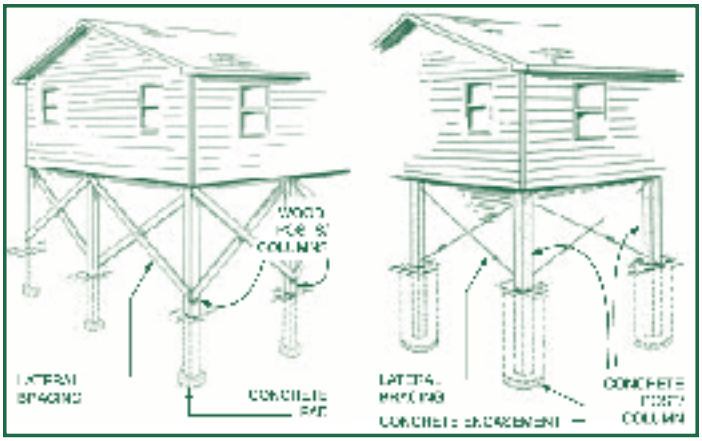
The space below all newly constructed, substantially damaged, and substantially improved buildings must either be free of obstructions or enclosed only by non-supporting breakaway walls, open wood latticework,or insect screening intended to collapse under water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or the supporting foundation system.

C. Typical Elevation Methods for Coastal Buildings

Frame, masonry veneer, and masonry houses on basement, crawlspace, and slab-on-grade foundations can also be elevated on open foundations consisting of piers, posts, columns, or pilings. Houses originally constructed on open foundations can also be elevated this way.

Posts or Columns

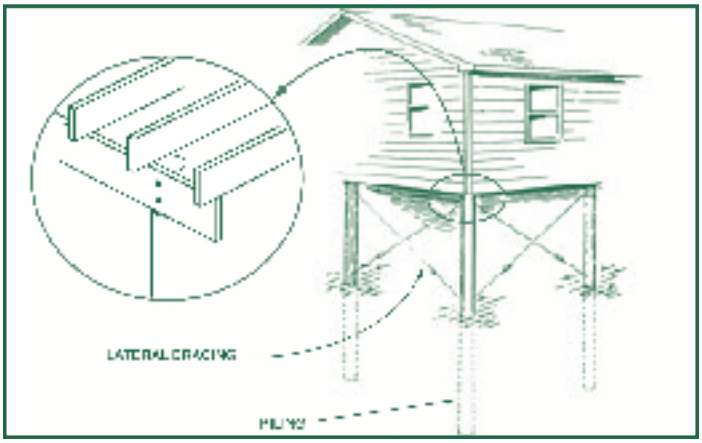
Posts are usually placed in drilled or excavated holes. Each post or column is either encased in concrete or anchored to a concrete pad. The house elevation process is the same as that described for piers; however, the existing foundation must be removed so that the posts or columns and their concrete encasements or pads can be installed. The figure below shows a house elevated on two types of post or column foundations.



House elevated on posts.

Pilings

Elevating on pilings is a more involved process. Pilings are usually driven into the ground or jetted in with a high-pressure stream of water. They are not supported by concrete footings or pads. Unlike the construction of wall, pier, or post or column foundations, the pile driving operation, which requires bulky, heavy construction machinery, cannot be carried out under a house that has been lifted on jacks. Instead, the house is usually lifted and moved aside until the pilings have been installed. Because the existing foundation is not used, it must be removed. The figure below shows a house elevated on a piling foundation.



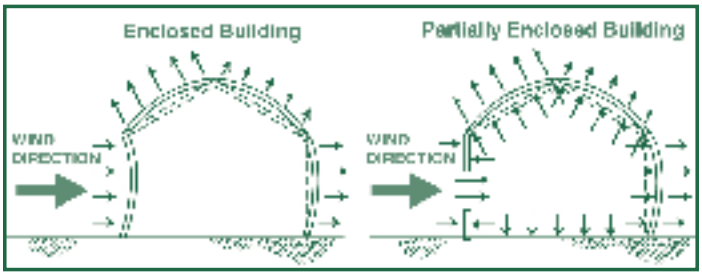
House elevated on pilings.

D. Coastal Houses Must Resist Wind and Water Forces

Wind Loads

The design for wind loads is essentially the same whether the winds are due to hurricanes, thunderstorms, or tornadoes.

- Windward walls and steep-sloped roofs are acted on by inward-acting,or positive, pressures.
- Leeward walls and steep- and low-sloped roofs are acted on by outward-acting, or negative, pressures.
- Air flow separates at sharp edges and at points where the building geometry changes.
- Localized suction, or negative, pressures at eaves, ridges, and the corners of roofs and walls are caused by turbulence and flow separation. These pressures affect loads on components and cladding.



Effect of wind on an enclosed building and a building with an opening.

Flood Loads

Flood waters can create a variety of loads on building components.

- hydrostatic, including buoyancy or flotation effects (from standing water, slowly moving water, and non-breaking waves)
- breaking wave
- hydrodynamic (from rapidly moving water, including broken waves and tsunami runup)
- debris impact (from waterborne objects)

E. Protecting Building Utilities

This section provides guidance for incorporating flood damage resistant techniques in the design and construction of building utilities. This guidance is applicable for both new construction and substantially improved buildings.The material is covered in terms of performance characteristics rather than specific construction techniques or approaches.

The NFIP requirements for building utilities are detailed in Section 44 of theCode of Federal Regulations (CFR) Chapter 1, Section 60.3(a). The NFI Prequires that all new and substantially improved structures located in flood prone areas be designed and constructed by methods and practices that minimize or eliminate flood damage to electrical, heating, ventilation, air conditioning, plumbing, and other building utility systems.

E. Protecting Furnaces, Boilers, Water Heaters, and Other Utilities

Floodwaters inundating a gas or oil furnace would extinguish the flame in the burner of the furnace and/or cause a short-circuit of the furnace's ignition control component and possible corrosion damage. In an electric furnace inundated by floodwaters, the heating element would short-circuit and require replacement. Further, floodwaters would cause silt or mud sedimentation within the components of any inundated furnace, i.e., the air intake, combustion chamber, blower, vent pipes, air ducts and pumps. Attempts to use the furnace with these materials within the components would be hazardous as it could cause short-circuits, fires, and/or improper/incomplete combustion.

Elevation

1. The most effective flood protection technique is to locate the furnace or boiler on a floor that is elevated above the DFE.
2. Elevation can also be achieved by using a lateral or in-line furnace that fits into the ductwork at any location above the DFE.
3. A furnace, boiler, or water heater can be located in the attic to protect it from floodwater inundation.
4. HVAC mechanical equipment can be located on a platform at or above the DFE even though the floor the platform is located on is below the DFE. The top of the platform must be above the DFE.

Fuel Storage Tanks

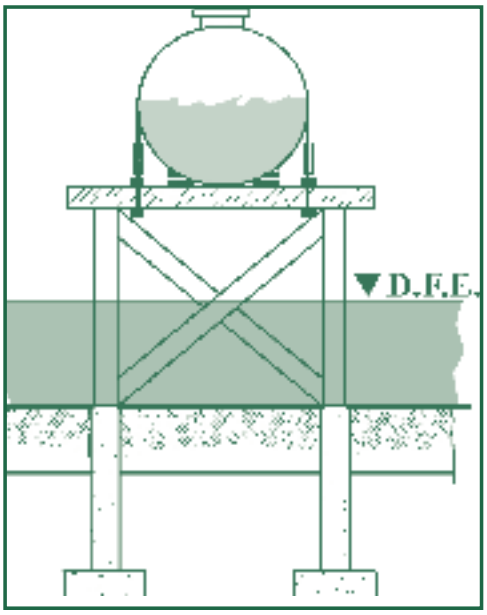
Where a structure is not connected to public gas service, the fuel for a non-electric Heating, Ventilating, and Air Conditioning (HVAC) system and other non-electric equipment is stored on-site in tanks either underground or above ground and inside or outside the building.

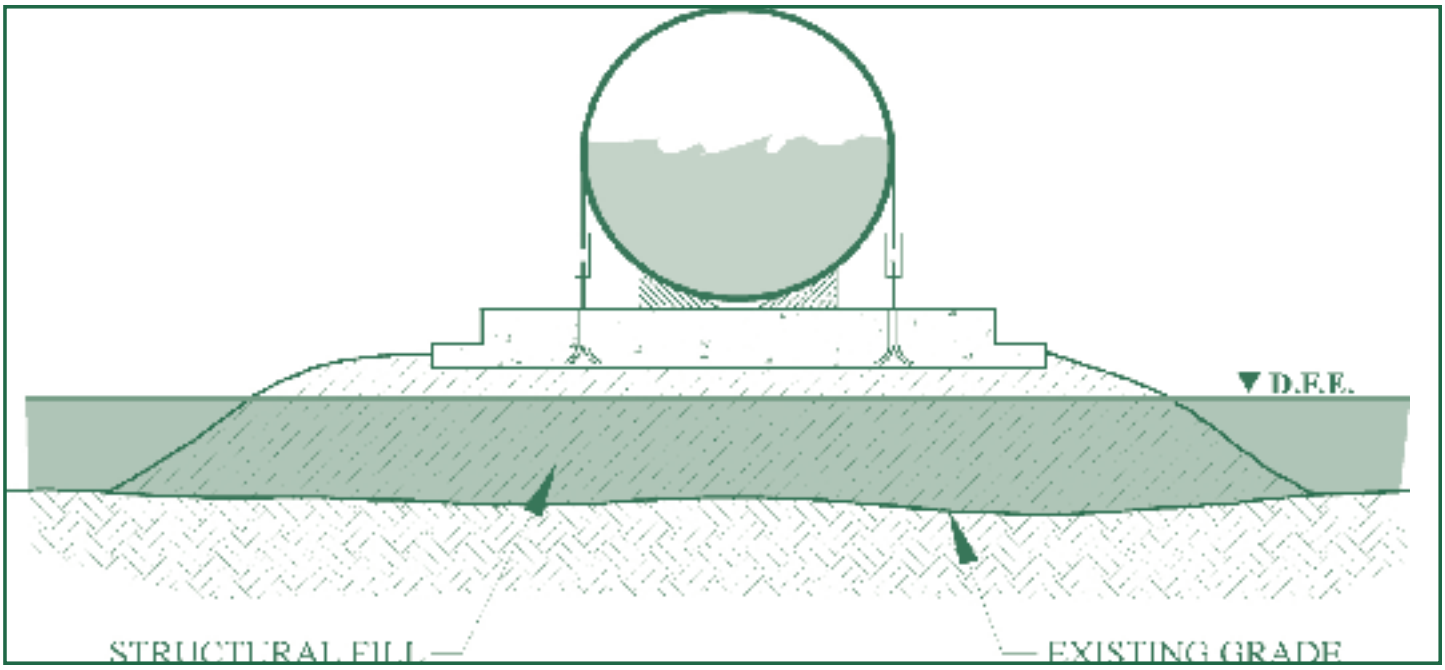
- An underground tank surrounded by floodwaters or saturated soil will be subjected to buoyancy forces that could push the tank upward. Such movement of a tank may cause a rupture and/or separation of the connecting pipes.
- Above ground tanks in V Zones and A Zones that experience velocity flow are not only subject to buoyancy forces, but they are also exposed to lateral forces caused by velocity flow, wave action, and debris impact.
- An underground tank in a V Zone can be uncovered and exposed by erosion and scour, making it even more vulnerable to buoyancy forces, velocity flows, wave action, and debris impact.

The most effective technique for providing flood protection for a fuel storage tank is elevation of the tank on a platform above the DFE. The figure below shows a tank on an elevated platform. The depth of the footing will be dependent upon the hazards at the site. The following outlines some additional considerations when protecting fuel systems:

- The tank should be anchored to the platform with straps, which would constrain the tank in wind, earthquake, and other applicable forces.
- In coastal zones, the straps should be made of non-corrosive material to prevent rusting.
- In velocity flow areas, the platform should be supported by posts or columns that are adequately designed for all loads including flood and wind loads.
- The posts or columns should have deep concrete footings embedded below expected erosion and scour lines.
- The piles, posts, or columns should be cross-braced to withstand the forces of velocity flow, wave action, wind, and earthquakes; cross-bracing should be parallel to the direction of flow to allow for free flow of debris.
- In non-velocity flow floodplains, elevation can also be achieved by using compacted fill to raise the level of the ground above the DFE and by strapping the tank onto a concrete slab at the top of the raised ground. The figure below shows a tank located atop fill.

A fuel tank elevated above the DFE on a platform in a velocity flow area.



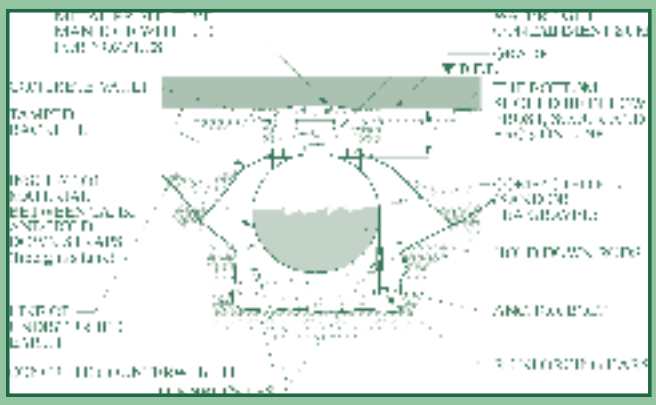


A fuel tank elevated on structural fill

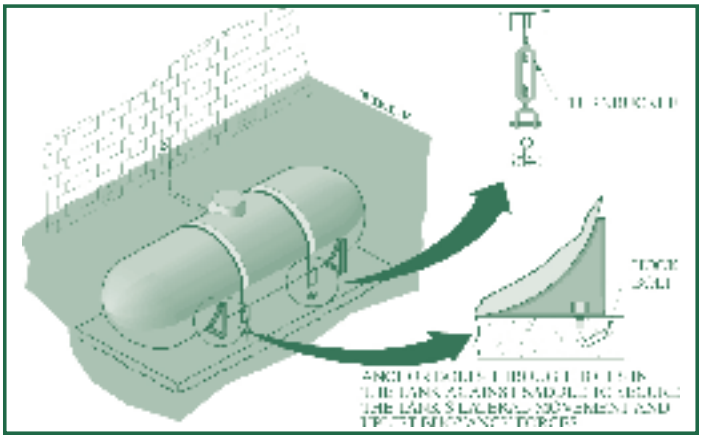
If a fuel tank must be located below the DFE in an SFHA, it must be protected against the forces of buoyancy, velocity flow, and debris impact. This can be achieved by the following methods:

1. A fuel tank located below ground in a flood-prone area can be anchored to a counterweight in order to counteract the buoyancy force that is exerted by saturated soil during a flood. One effective method is to anchor the fuel tank to a concrete slab with (non-corrosive) hold-down straps, as shown in the figure below. The straps must also be engineered to bear the tensile stress appliedby the buoyancy force.

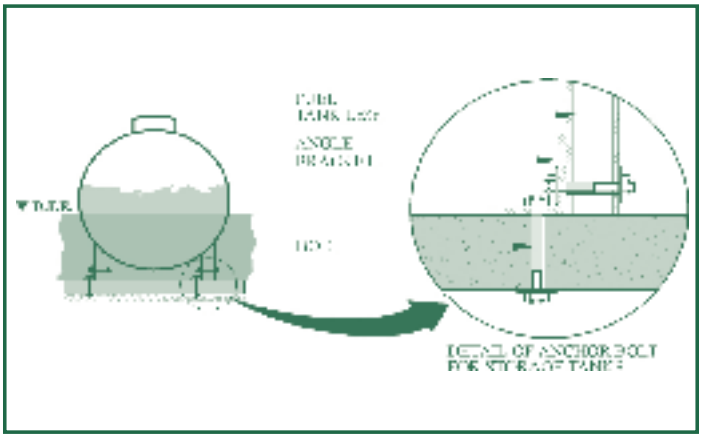
2. An alternative design technique involves strapping the tank to con-crete counterweights on opposite sides of the tank, as shown in the figure below. The use of this technique is ideal for existing tanks servicing substantially improved structures. A fuel tank located above ground but below the DFE must be secured against flotation and lateral movement. This requirement applies as well to portable fuel tanks such as propane tanks. In A



An underground fuel tank anchored to a concrete counter-weight



A typical tie down strap configuration of a horizontal propane tank



A typical tie down strap configuration of a horizontal propane tank using brackets

Zones, that are not subject to velocity flows, the following techniquescan be used:

Mounting and strapping a tank onto a concrete slab or strapping a tank onto concrete counterweights on both sides of the tank. The anchoring straps are typically connected to anchor bolts by turnbuckles that are installed when the concrete is poured.

In coastal areas the strapping mechanism for securing a fuel tank onto a concrete slab must be made of non-corrosive material. The total weight of the counterweights or the concrete slab must be enough to counteract the buoyancy force expected to be exerted on the tank surrounded by floodwater.

CHAPTER 5: FEDERAL, STATE, AND LOCAL ROLES FOR FLOODPLAIN MANAGEMENT

A. The National Flood Insurance Program (NFIP)

FEMA is responsible for the administration of the NFIP, a Federal program enabling property owners to purchase flood insurance. This insurance is designed to provide a program alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

The NFIP is based upon the establishment of an agreement between local communities and the Federal government, that if a community will enforce certain zoning and building construction practice standards in the 100-year floodplain, the Federal government will make affordable flood insurance available within the community; thereby providing some financial protection against flood losses when they occur.

B. Virginia's Floodplain Management Plan

In 1987, the Department of Conservation and Recreation (DCR) worked with the General Assembly to place programs related to flood protection into one agency in an effort to improve Virginia's flood protection efforts. This brought about the General Assembly enacting the Virginia Flood Damage Reduction Act in 1989, which made DCR responsible for coordination of all floodplain management programs in the Commonwealth.

The manager of the Floodplain Program within DCR is designated as the State Coordinator for the NFIP. The NFIP Coordinator's role is to oversee and coordinate FEMA's National Flood Insurance Protection program throughout the Commonwealth of Virginia.

C. Local Community Responsibilities in Floodplain Management

The principal local control of flood hazard areas is through zoning, subdivision regulations, building and housing codes, and sanitary codes with specific flood hazard provisions.

C.1 Zoning

Zoning divides a government unit into specified areas for the purpose of regulating (a) the use of structures and land, (b) the size of structures, and (c) the size of lots and density of use. Zoning may be used to set special standards for land uses in flood hazard areas including specification of minimum floor elevations.

C.2 Subdivision Regulations

Subdivision Regulations guide the process of land division to assure that lots are suitable for intended use without putting a disproportionate burden on the community. They also control improvements such as roads, sewers, water, and recreation areas. Subdivision Regulations often require (a) installing adequate drainage facilities, (b) showing the location of flood hazard areas on the plat, (c) avoiding encroachment into floodplain areas, (d) determining the most appropriate means of elevating a building above the regulatory flood height in accordance with sound engineering practice, and (e) placing streets and public utilities relative to the selected flood protection elevation.

C.3 Building Codes

The Virginia Uniform Statewide Building Code (USBC) prescribes mandatory building regulations for the construction of buildings and structures and the equipment in them and local option building regulations for the maintenance of buildings and structures and the equipment in them. The purpose of the USBC is to ensure safety to life and property from all hazards incident to structure design, construction, occupancy, repair, maintenance, renovation, removal or demolition, including buildings and structures in flood hazard areas.

C.4 Sanitary and Well Codes

Sanitary and Well Codes establish minimum standards for waste water disposal and water supply. Sanitary Codes commonly prohibit onsite waste disposal facilities such as septic tank systems in areas of high groundwater and flood hazards. Sometimes elevation or floodproofing requirements are established for public sewer systems. Well Codes often establish special floodproofing requirements for facilities located in flood hazard areas in order to reduce their potential for contamination during flooding. Current standards addressing the location of these facilities are available through the Virginia Department of Health (VDH).

A. Building and Developing Permits

There are many activities associated with development and redevelopment that require permits. Your local building, zoning and planning officials are good sources of information regarding the specific permits required in your locality. Also, local design professionals should be familiar with permitting requirements that may affect your development or redevelopment project.

These are just some of the activities that require permits:

- Constructing new buildings
- Additions to existing buildings
- Substantially improved existing buildings
- Interior renovations to existing buildings
- Placing manufactured (mobile) homes
- Subdivision of land
- Temporary buildings and accessory structures
- Agricultural buildings
- Parking or storage of recreational vehicles
- Storing materials, including gas and liquid tanks
- Constructing roads, bridges or culverts
- Filling, grading, excavating, mining and dredging
- Altering stream channels

Joint Permit Application

The Joint Permit Application is used by the US Army Corps of Engineers, the Virginia Department of Environmental Quality and the Virginia Marine Resources Commission and local wetland boards for permitting projects that impact water and wetland resources. This one application is submitted to one agency and then shared with other involved agencies to provide a complete review of the project. Completing this application is strongly recommended for all projects hat may have some impact to water or wetland resources.

B. Preparing for Floods

Preparation for floods and flood fighting plans, including contingency and emergency floodproofing, can be completed in anticipation of flooding for areas where flood warning time permits. During and immediately after a flood, emergency activities may include actions to remove people and property from areas which may be flooded; sandbagging around individual structures and constructing dikes and other activities to direct floodwater away from vulnerable areas; search and rescue efforts during and immediately after flooding; and immediate post-flood measures to protect the health and safety of area residents.

C. Emergency Evacuation

Northeasters are usually predicted only a day or two in advance and the intensity is difficult to forecast, making evacuation plans difficult to formalize. Large scale evacuation does not generally occur before or during a northeaster; however, due to erosion of the shoreline and high tides, first row waterfront properties and their occupants may be in danger from erosion and entire waterfront communities from flooding.

D.Emergency Shelters

When a hurricane is predicted to make landfall in a region, local authorities will open shelters for residents that may need to evacuate their homes. Buildings designated as shelters are generally on higher ground and built to withstand high winds. Overall, the shelter space for residents is considered adequate. When residents go to a shelter, they need to take enough food, water, and bedding for their entire family as shelters are usually set up at the last minute and have limited supplies for flood preparedness and recovery.

E. After the Storm

Immediate recovery within a locality involves: debris removal, restoration of utilities, protection of exposed public and private property, recovery and reconstruction. Listed below are a few general guidelines; additional information on storm recovery is readily available from the FEMA, state agencies and from many internet sites.

After a major storm, many dangers exist in and around homes and businesses. Downed electrical wires could still be live; tree branches may fall; animals (particularly snakes and rodents) that may have been displaced may move into your home; and even more serious, there may be structural damage such as; gas leaks; or household chemicals, like medicines, bleaches, kerosene or other flammable liquids, may have spilled.

F. Assessing the Damage

Check foundations, footings, and walls for damage. Walls should be plumb. All appliances and electronic equipment should be checked out by a qualified repairman to determine if the items can be salvaged. Salt water from the storm surge and flooding as well as humidity in the days following the disaster can hamper restoration of personal property.

G. Insurance and Disaster Assistance

Most homeowners do not realize until after an emergency that their homeowner's policies do not cover flood damage, and in order to receive federal disaster assistance, the area must be declared a disaster region by the President.

The NFIP defines flooding as a general and temporary condition during which the surface of normally dry land is partially or completely inundated. Two adjacent properties or two or more acres must be affected. Flooding can be caused by any one of the following:

- The overflow of inland or tidal waters,
- The unusual and rapid accumulation or runoff of surface waters from any source such as heavy rainfall,
- The incidence of mudslides or mudflows caused by flooding which are comparable to a river of liquid and flowing mud,
- The collapse or destabilization of land along the shore of a lake or other body of water resulting from erosion or the effect of waves or water currents exceeding normal, cyclical levels.

When disaster strikes, these steps can help the claim process move more smoothly.

Contact your insurance agent. Make sure you leave a number where you can be reached as well as your policy number and the property address. Take pictures of the damage.

Protect property from further damage or theft. Save receipts for what you spend in your recovery efforts and submit them to the insurance company.
Dry out water-damaged furnishings and clothing as soon as possible to prevent fading and deterioration.
Keep accurate records:

- A list of cleaning and repair bills, including materials and cost of rental equipment.
- A list of additional living expenses if your home is so severely damaged that you must live elsewhere while repairs are made. Include motel and restaurant bills, home and car rental.
- A list of actual losses including furniture, appliances, clothing, paintings, foods and equipment.
- Try to document the value of each object lost. Bills of sale, canceled checks, charge account records, and insurance evaluations are good evidence.

Contact a reputable firm to repair damage and be wary of door-to-door salesman after a disaster.
Don't be in a hurry to settle a claim. It is advisable to wait until all damage is discovered.

H. Potential Flood Hazard Mitigation Measures

Flood Protection Elevation and Risk

When you retrofit your house, one of the most important things you will do ischoose a level of flood protection. In other words, will you protect your housefrom the base flood, the 500-year flood, or some other flood?

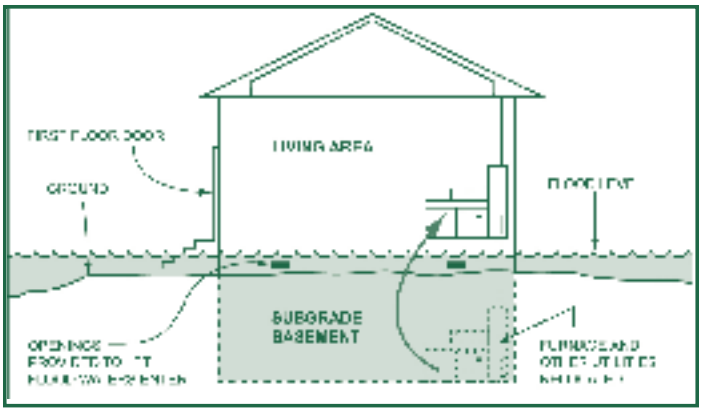
Different retrofitting methods protect your house in different ways. For example, when you elevate your house, you protect it by raising its lowest floor to a specified elevation. In wet floodproofing and dry floodproofing, you use flood-resistant materials, sealants, and shields to protect the part of your house below a specified elevation. When you protect your house with a levee or floodwall, the top of the levee or floodwall must be at a specified elevation.

Elevation

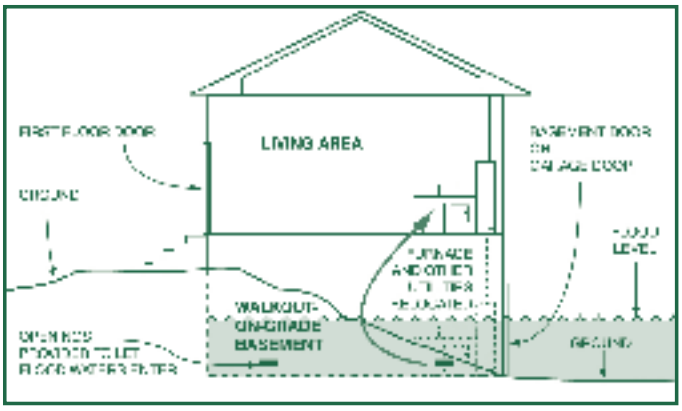
Elevating a house to prevent flood waters from reaching living areas is an effective retrofitting method. The goal of the elevation process is to raise the lowest floor to or above the FPE(Flood Protection Elevation). You can do this by elevating the entire house, including the floor, or by leaving the house in its existing position and constructing a new, elevated floor within the house. The method used depends largely on construction type, foundation type, and flooding conditions.

Wet Floodproofing

Wet floodproofing a house is modifying the uninhabited portions of the house (such as a crawlspace or an unfinished basement) so that floodwaters will enter but not cause significant damage to either the house or its contents. The purpose of allowing water into portions of the house is to ensure that the interior and exterior hydrostatic pressures will be equal. Allowing these pressures to equalize greatly reduces the likelihood of wall failures and structural damage. Wet floodproofing is often used when all other retrofitting methods are either too costly or are not feasible. But it is practical in only a limited number of situations.



A house with a wet floodproofed subgrade basement. (If this house were substantially damaged or substantially improved, the basement would have to be filled in.



A house with a wet floodproofed walkout-on-grade basement

Relocation

Moving your house to high ground, outside the flood hazard area, is the most effective of the retrofitting methods described in this guide. Retrofitting literature commonly refers to this method as relocation. When space permits, you may even be able to move your house to another location on the same piece of property. Relocating a house usually involves jacking it up and placing it on a wheeled vehicle, which delivers it to the new site. The original foundation cannot be moved, so it is demolished and a new foundation is built at the new site.

Dry Floodproofing

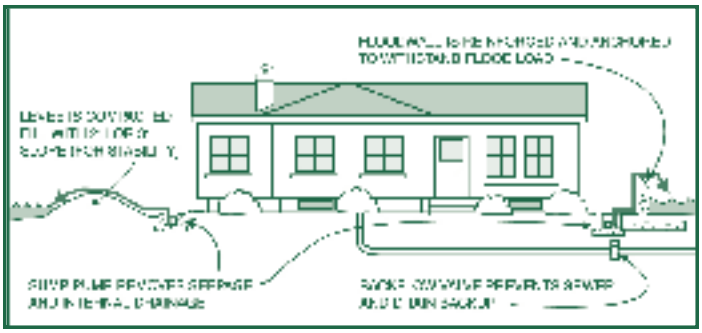
In some situations, a house can be made watertight below the FPE, so that flood waters cannot enter. This method is called “dry floodproofing.” Making the house watertight requires sealing the walls with waterproof coatings, impermeable membranes, or supplemental layers of masonry or concrete. Also, doors, windows, and other openings below the FPE must be equipped with permanent or removable shields, and backflow valves must be installed in sewer lines and drains. The flood characteristics that affect the success of dry floodproofing are flood depth, flood duration, flow velocity, and the potential for wave action and floodborne debris.

Flood depth is important because of the hydrostatic pressure that flood waters exert on walls and floors. Because water is prevented from entering a dry floodproofed house, the exterior pressure on walls and floors is not counteracted as it is in a wet floodproofed house.

Duration of flooding is critical because most sealing systems will begin to allow some amount of see page after prolonged periods of exposure to water. If your house is in an area where flood waters remain high for days, you should use a different retrofitting method.

Levees and Floodwalls

Levees and floodwalls are types of flood protection barriers. A levee is typically a compacted earthen structure; a floodwall is an engineered structure usually built of concrete, masonry, or a combination of both. When these barriers are built to protect a house, they are usually referred to as“residential,” “individual,” or “on-site” levees and floodwalls. The practical heights of these levees and floodwalls are usually limited to 6 feet and 4 feet, respectively.



House protected by levee (left) and floodwall (right).

Demolition

Demolition, as a retrofitting method, is tearing down a damaged house and either rebuilding properly somewhere on the same property or moving to a house on other property, outside the regulatory floodplain. This retrofitting method may be the most practical of all those described in this guide when a house has sustained extensive damage, especially severe structural damage.

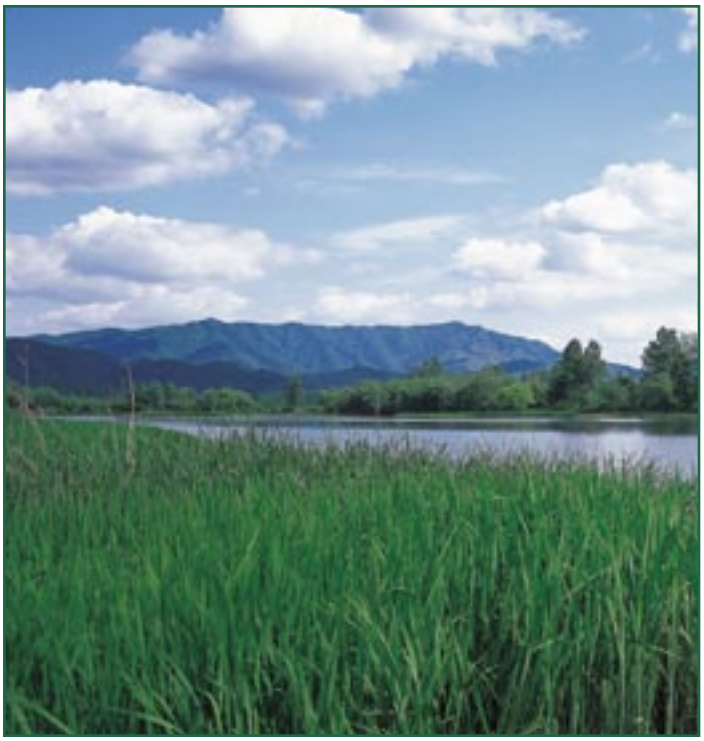
You are now ready to decide which retrofitting method is right for your house. Your decision will be based primarily on legal requirements, the technical limitations of the methods, and cost. Other considerations might include such things as the appearance of the house after retrofitting and any inconvenience resulting from retrofitting. Making a decision involves four steps:

CHAPTER 7: MAINTAINING NATURAL FLOODPLAIN RESOURCES

A. Benefits of Natural Floodplain Resources

Natural beneficial values of floodplains are those features that serve the interests of the ecological floodplain community and benefit society's developed communities. Floodplains left in an undeveloped, unaltered state are areas where several unique natural and historic resource values converge. Some of these values are outlined in the list below:

- Water supply
- Water quality
- Flood control
- Fisheries habitat
- Wildlife habitat
- Recreation
- Historic



Buffers and Water Quality

One way of ensuring that structures are located at a safe elevation with respect to flood hazards is through buffers. A buffer around a particular regulatory limit (e.g. BFE, PMF(Probable Maximum Flood), etc.) provides a factor of safety, ensuring that buildings are out of harm's way.

These buffers can help protect the lake system from excessive bank and watershed erosion. Erosion within a reservoir watershed can be harmful in several ways. Sediment is generally associated with deleterious conditions such as turbidity, low oxygen, nutrients and perhaps most significantly, reduction of reservoir storage volume.

Other sources of information on reservoir management can be obtained from the following sources:

- Environmental Protection Agency (http://www.epa.gov/ebtpages/water.html)
- Virginia DCR (Soil and Water Conservation) (http://www.dcr.virginia.gov/sw/)
- Dam Safety and Floodplain Management (http://www.dcr.virginia.gov/sw/damsafty.htm)
- Chesapeake Bay Local Assistance (http://www.cblad.virginia.gov/)
- Virginia DEQ (http://www.deq.virginia.gov/waterresources/)
- Virginia Department of Health (http://www.vdh.state.va.us/onsite/)
- North American Lake Management Society (http://www.nalms.org/)
- The Virginia Lakes and Watersheds Association (http://www.gky.com/VLWA/index.htm)

B. Management of Natural and Beneficial Values

The management strategies for the protection of natural and beneficial values of floodplains can span a wide range of applications. Some of these strategies are described below to provide a frame of reference for understanding the protection of natural and beneficial values and consequently provide mitigation for flood damages.

Preservation

A preservation approach for the protection of floodplains would entail a no alteration strategy whereby the natural features of a floodplain would be allowed to remain undisturbed. This would apply to areas that are presently undeveloped: wilderness areas, rural areas, even some urban river corridor greenways have floodplain reaches which are "managed" through a preservation strategy.

Conservation

The protection of natural and beneficial values through a conservation management approach involves a combination of strategies where some preservation practices are applied and some low impact alterations of a floodplain are allowed. Implementing a conservation approach is a realistic and reasonable goal for most Virginia communities.

Restoration

This strategy allows for the identification of critical lands and the expenditure of resources to recover lost benefits. Acquisition and relocation programs are an example of a restoration strategy. Once these lands are cleared of structures, other uses compatible with the floodplain and the environment could be developed or restored.

Mitigation

At times, driving social and economic pressures in support of development and construction in a floodplain are so strong that the projects will proceed despite the loss of known beneficial natural values. From an ecological systems viewpoint, it might be possible to transfer, preserve, or recreate similar beneficial natural values within the system on adjoining land.

Cooperation

This can be the most effective tool of all. If realistic environmental goals and objectives are presented to developers and project designers during initial plan review meetings. These goals and objectives can often be incorporated in the design process with minimal impacts and perhaps an enhancement to the proposed project.

Other concerns for areas in close proximity to lakes and reservoirs deal more specifically with water quality. Two areas that are regulated for health and quality impacts are:

- Sanitary sewer design and on-site treatment systems
- The Chesapeake Bay Program in certain areas of the State

These programs should be coordinated by local officials through the communities zoning ordinance and development regulations. Regulations and programs related to these areas should be explored prior to development in the area of a lake or reservoir.